within a certain range rotor 22 may be decelerated without the need for brakes. Furthermore, if transmission 20 is of the type which can be electronically shifted control 54 can be configured to control shifting and gear synchronization, if necessary, speed matching (hydrostatic synchronization). Finally, the shift between the pure hydrostatic mode and the hydro-mechanical mode may be made at synchronism without torque interruption.

It will be understood that the foregoing description is of a preferred embodiment of this invention and that the invention is not limited to the specific forms shown. Other modifications may be made in the design and arrangement of other elements without departing from the scope of the invention as expressed in the appended claims.

What is claimed is:

1. A hydro-mechanical transmission comprising:

a transmission housing;

a clutch assembly rotatably supported by the housing, the clutch assembly including a first input shaft, a second input shaft and a first output shaft, the clutch assembly being configured to selectively couple the output shaft to the first and second input shafts;

a motor coupled to the second input shaft;

a differential assembly rotatably supported by the housing, the assembly including a third input shaft coupled to the first output shaft, a fourth input shaft coupled to the motor, and a second output shaft, wherein the speed of the second output shaft is a combination of the speeds of the third and fourth input shafts;

an output speed transducer supported by the housing to generate an output speed signal representative of the speed of the second output shaft;

an electrically controlled clutch actuating circuit; and

a control circuit coupled to the speed transducer and the actuating circuit to control the engagement and disengagement of the first and second input shafts to the first output shaft.

2. The transmission of claim 1, wherein the differential assembly is a planetary gear arrangement comprising:

a ring gear coupled to the third input shaft;

a sun gear coupled to the fourth input shaft; and

at least one planetary gear coupled to the output shaft and engaged with the ring and sun gears.

3. The transmission of claim 1, wherein the motor is a hydraulic motor.

4. The transmission of claim 2, wherein the motor is a hydraulic motor.

5. The transmission of claim 4, further comprising:

a hydraulic pump coupled to the first input shaft; and

a hydraulic conduit coupled between the motor and the pump to convey hydraulic fluid therebetween.

6. The transmission of claim 1, further comprising:

an input speed transducer supported by the housing to generate an input speed signal representative of the speed of the first input shaft.

7. The transmission of claim 6, further comprising:

an electrically controlled motor speed control coupled to the motor and the control circuit, wherein the control circuit applies a speed signal to the control to operate the control to control the speed of the motor to maintain a selected speed difference between the first input shaft and the second output shaft.

8. The transmission of claim 7, wherein the clutch actuating circuit comprises:

a hydraulic actuating assembly coupled to the clutch assembly to engage and disengage the output shaft from the first and second input shafts;

a hydraulic fluid source; and

a solenoid arrangement coupled to the control circuit to control the flow of hydraulic fluid between the actuating assembly and the fluid source.

9. The transmission of claim 7, wherein the motor is a hydraulic motor and the motor speed control comprises a hydraulic pump coupled to the first input shaft and in fluid communication with the hydraulic motor, the pump having an electronic displacement control coupled to the control circuit.

10. The transmission of claim 7, further comprising a multi-speed gear transmission coupled to the second output shaft.

11. A method for increasing the speed of the output of a transmission of the type including: a transmission housing; a clutch assembly rotatably supported by the housing the clutch assembly including a first input shaft, a second input shaft and a first output shaft, the clutch assembly being configured to selectively couple the output shaft to the first and second input shafts; a motor coupled to the second input shaft; and a differential assembly rotatably supported by the housing, the assembly including a third input shaft coupled to the first output shaft, a fourth input shaft coupled to the motor, and a second output shaft, wherein the rotational speeds of the second output shaft is a combination of the rotational speeds of the third and fourth input shafts, and the rotational speeds of the first input shaft and the second output shaft is stationary; the method comprising the steps of:

operating the first input shaft at a first rotational speed;

operating the clutch assembly to couple only the second input shaft with the first output shaft;

monitoring the first rotational speed;

increasing the rotational speed of the motor to a speed which rotates the second output shaft at a second rotational speed such that the ratio of the first and second rotational speeds is within a predetermined range of the predetermined ratio; and

operating the clutch assembly to couple the first input shaft with the first output shaft after the ratio of the first and second rotational speeds is within the predetermined range.

12. The method of claim 11, further comprising the step of operating the clutch assembly to disengage the second input shaft from the first output shaft.

13. The method of claim 12, further comprising the step of setting the rotational speed of the motor to a speed which rotates the fourth input shaft at a rotational speed which rotates the second output shaft at a third rotational speed such that the ratio of the first and third rotational speeds is greater than the predetermined ratio.

14. The method of claim 12, further comprising the step of setting the rotational speed of the motor to a speed which rotates the fourth input shaft at a rotational speed which rotates the second output shaft at a fourth rotational speed such that the ratio of the first and fourth rotational speeds is less than the predetermined ratio.

15. A threshing system for a combine comprising:

a transmission housing;

a clutch assembly rotatably supported by the housing, the clutch including a first input shaft, a second input shaft and a first output shaft, the clutch assembly being configured to selectively couple the output shaft to the first and second input shafts;

a hydraulic motor coupled to the second input shaft;

a differential assembly rotatably supported by the housing, the assembly including a third input shaft coupled to the first output shaft, a fourth input shaft coupled to the motor, and a second output shaft, wherein the speed of the second output shaft is a combination of the speeds of the third and fourth input shafts;

an internal combustion engine coupled to the first input shaft;

a hydraulic pump coupled to the engine and in fluid communication with the hydraulic motor; and

a threshing rotor coupled to the second output shaft.

16. The system of claim 15, wherein the differential assembly is a planetary gear arrangement comprising:

a ring gear coupled to the third input shaft;

a sun gear coupled to the fourth input shaft; and

at least one planet gear coupled to the output shaft and engaged with the ring and sun gears.

17. The system of claim 15, further comprising:

an output speed transducer supported by the housing to generate an output speed signal representative of the speed of the second output shaft;

an electrically controlled clutch actuating circuit; and

a control circuit coupled to the speed transducers and the actuating circuit to control the engagement and disengagement of the first and second input shafts to the first output shaft.

18. The system of claim 17, wherein the hydraulic pump is an electronically controlled variable displacement pump.

19. The system of claim 18, wherein the control circuit is coupled to the variable displacement pump to control the speed of the motor to maintain a selected speed difference between the first input shaft and the second output shaft.

20. The system of claim 19, wherein the clutch actuating circuit comprises:

a hydraulic actuating assembly coupled to the clutch assembly to engage and disengage the output shaft from the first and second input shafts;

a hydraulic fluid source; and

a solenoid arrangement coupled to the control circuit to control the flow of hydraulic fluid between the actuating assembly and the fluid source.

21. The system of claim 15, further comprising a multi-speed gear transmission coupled to the second output shaft.

22. A method for increasing the speed of a threshing system rotor using a transmission including: a transmission housing, a clutch assembly rotatably supported by the housing, the clutch assembly including a first input shaft, a second input shaft and a first output shaft, the clutch assembly being configured to selectively couple the output shaft to the first and second input shafts; a hydraulic motor coupled to the second input shaft; a differential assembly rotatably supported by the housing; the assembly including a third input shaft coupled to the first output shaft; a fourth input shaft coupled to the motor, and second output shaft coupled to the threshing rotor, wherein the rotational speed of the rotor is a combination o the rotational speeds of the third and fourth input shafts, and the rotational speeds of the first input shaft and the second output shaft are a predetermined ration when the fourth input shaft is stationary; an internal combustion engine coupled to the first input shaft; and a hydraulic pump coupled to the engine and in fluid communication with the hydraulic motor; the method comprising the steps of:

operating the first input shaft at a first rotational speed defined by the speed of the engine;

operating the clutch assembly to couple only the second input shaft with the first output shaft;

monitoring the first rotational speed;

increasing the rotational speed of the motor to a speed which rotates the rotor at a second rotational speed such that the ratio of the first and second rotational speeds is within a predetermined range of the predetermined ratio; and

operating the clutch assembly to couple the first input shaft with the first output shaft after the ration of the first and second rotational speeds is within the predetermined range.

23. The method of claim 22, further comprising the step of operating the clutch to disengage the second input shaft from the first output shaft.

24. The method of claim 22, further comprising the step of setting the rotational speed of the motor to a speed which rotates the fourth input shaft at a rotational speed which rotates the second output shaft at a third rotational speed such that the ratio of the first and third rotational speeds is greater than the predetermined ratio.

25. The method of claim 22, further comprising the step of setting the rotational speed of the motor to a speed which rotates the fourth input shaft at a rotational speed which rotates the second output shaft at a fourth rotational speed such that the ratio of the first and fourth rotational speeds is less than the predetermined ratio.

26. A hydro-mechanical transmission comprising:

a transmission housing;

a clutch assembly rotatably supported by the housing, the clutch assembly including a first input shaft, the clutch assembly being configured to selectively couple the output shaft to the first and second input shafts;

a motor coupled to the second input shaft;

a differential assembly rotatably supported by the housing, the assembly including a third input shaft coupled to the first output shaft, a fourth input shaft coupled to the motor, and a second output shaft, wherein the speed of the second output shaft is a combination of the speeds of the third and fourth input shafts;

a speed transducer supported by the housing to generate a speed signal representative of the speed of one of the first input shaft and the second output shaft;

an electrically controlled clutch actuating circuit; and

a control circuit coupled to the speed transducer and the actuating circuit to control the engagement and disengagement of the first and second input shafts to the first output shaft.

27. The system of claim 15, further comprising:

an input speed transducer supported by the housing to generate an input speed signal representative of the speed of the first input shaft;

an output speed transducer supported by the housing to generate an output speed signal representative of the speed of the second output shaft;

an electrically controlled clutch actuating circuit; and

a control circuit coupled to the speed transducers and the actuating circuit to control the engagement and disengagement of the first and second input shafts to the first output shaft.

28. A threshing system for a combine comprising:

a transmission housing;

a clutch rotatably supported by the housing, the clutch including a first input shaft, a second input shaft and a first output shaft, the clutch being to selectively couple the output shaft to the first and second input shafts;

a hydraulic motor coupled to the second input shaft;

a differential assembly rotatably supported by the housing, the assembly including a third input shaft coupled to the first output shaft, a fourth input shaft coupled to the motor, and a second output shaft, wherein the speed of the second output shaft is a combination of the speeds of the third and fourth input shafts;

an internal combustion engine coupled to the first input shaft;

a hydraulic pump coupled to the engine and in fluid communication with the hydraulic motor;

a multi-speed gear transmission coupled to the second output shaft; and

a threshing rotor coupled to the second output shaft.]

29. A combine for harvesting a crop due, in part, to the rotation of a rotor, the combine comprising:

an engine;

a hydraulic pump driven by the engine;

a hydraulic motor driven by the pump, wherein the motor drives the rotor; and

an electronic control circuit, wherein the electronic control circuit maintains a selected rotor speed by regulating the speed of the ~~motor.~~

30. The combine of Claim 29, wherein the rotor is an agricultural implement.

31. The combine of Claim 30, wherein the rotor is a threshing rotor.

32. The combine of Claim 29, wherein the hydraulic pump is an electronically controlled variable displacement pump.

~~33. The combine of Claim 32, wherein the electronic control~~ circuit monitors the rotor speed and determines the appropriate control signals to send to the variable displacement pump to maintain the selected rotor speed.

34. The combine of Claim 33, wherein ~~the variable displacement~~ pump is controlled by changing the pump displacement.

35. A combine for harvesting a crop, comprising:

an engine;

an electronically controlled variable displacement hydraulic pump driven by the engine;

a hydraulic motor driven by the hydraulic pump;

a rotor driven by the hydraulic motor; and

a control circuit that electronically controls the rotor speed by regulating the speed of the hydraulic motor via control of the variable displacement hydraulic pump.

36. The combine of Claim 35, wherein the rotor is an agricultural implement.

37. The combine of Claim 36, wherein the rotor is a threshing rotor.

38. The combine of Claim 35, wherein the control circuit monitors the rotor speed and determines the appropriate control signals to send to the variable displacement hydraulic pump to maintain a predetermined rotor speed.

39. The combine of Claim 38, wherein the variable displacement pump is controlled by changing the pump displacement.